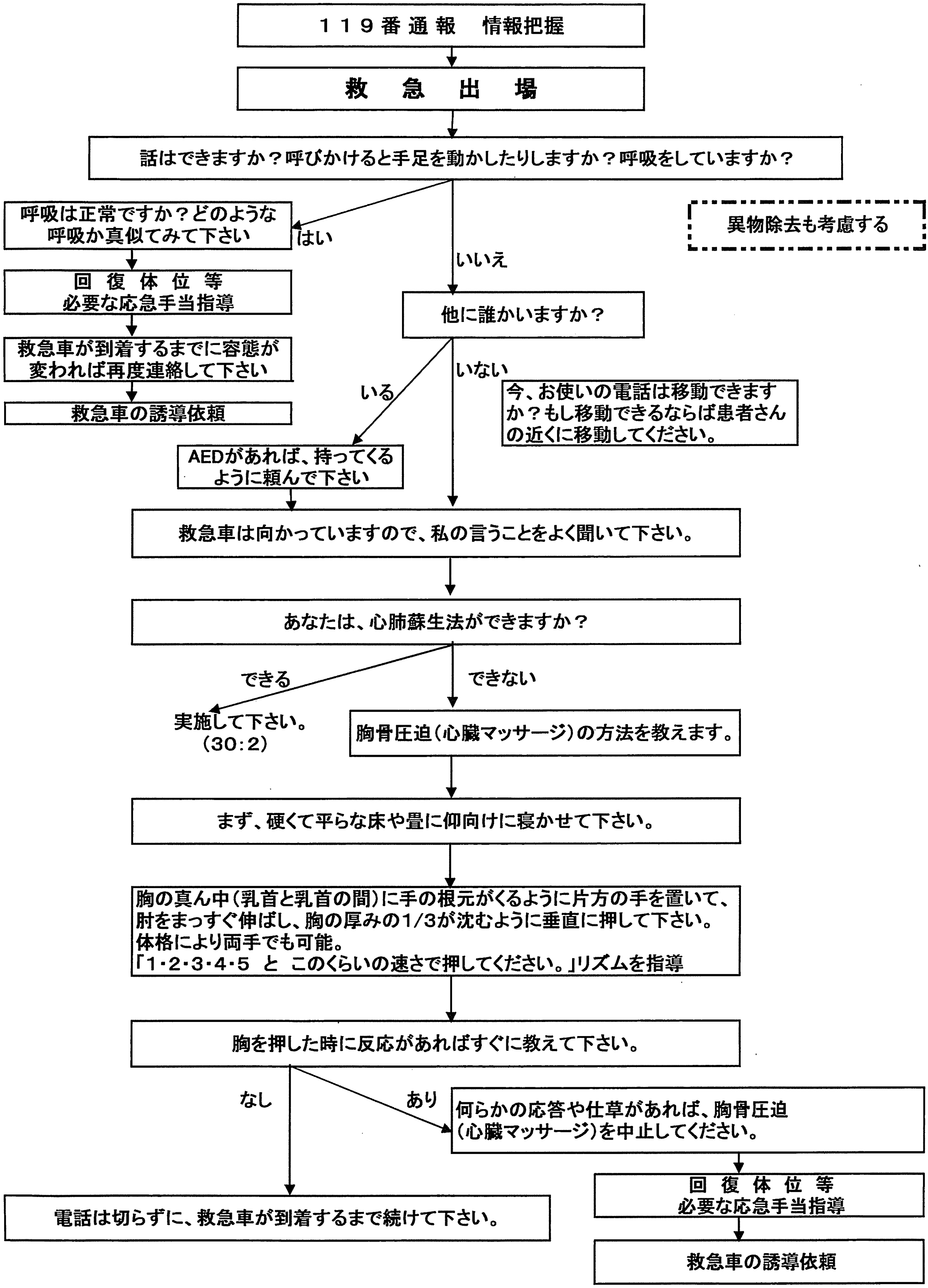
# 心肺蘇生法（小児）1歳以上8歳未満



# 心肺蘇生法（小児・1歳以上8歳未満が対象）口頭指導の詳細

| | |
|---|---|
| 反応の確認 | 患者の肩を軽く叩いたり、大きな声でよびかける。何らかの応答や仕草があれば反応があると判断する。<br>例：「目を開けてくださいの呼びかけで開眼する。」など |
| 気道の確保 | 患者の肩あたりの横に座り、患者の頭側（おでこ）に手をあて、もう一方の手の指2本で顎先を上に持ち上げ、頭を後ろにそらせてください。 |
| 呼吸の確認 | 気道確保をしたままの状態で、あなたの頬と耳を患者の鼻と口に近づけてください、息の音が聞こえますか、頬で感じられますか、あなたの目で見て患者の胸やおなかは動いてますか。（10秒以内で確認）<br>＊死戦期呼吸（あえぎ呼吸とは顎と、のど仏が上下する様子でいかにも呼吸している様に見える）は呼吸停止と判断すること。 |
| 異物の確認 | 目で見える異物は取り除く。原則として可能であれば腹部突き上げ法（ハイムリック法）を優先して指導する。　＊気道異物による窒息が原因であると判明していても異物除去が不可能であれば、こだわることなく胸骨圧迫（心臓マッサージ）を指導する。 |
| 人工呼吸 | 気道確保をしたままの状態で患者の頭側（おでこ）に当てている手で患者の鼻をつまんでください。 あなたの口を患者の口より大きく開けて覆いかぶせて、息を吹き込んでください。患者の胸が軽く膨らむ程度で1回1秒ぐらいで2回吹き込んでくださいと指導する。<br>＊人工呼吸については省略が可能。 |
| 胸骨圧迫<br>心臓マッサージ | 胸の真ん中（乳首と乳首の間）に片方の手の付け根付近を当て、肘をまっすぐ伸ばし、胸の厚みの1/3が沈むように垂直に押して下さい。<br>「1・2・3・4・5　と　このくらいの速さで押してください。」リズムを指導<br>＊1分間に100回のリズムで絶え間ない胸骨圧迫が重要である。 |
| CPR | 胸骨圧迫「1・2・3・4・5　と　このくらいの速さで30回押してください。」と人工呼吸を繰り返すように指導する。 |
| AED | AEDが到着すれば、まず電源を入れて、後は音声メッセージに従うように指導する。<br>＊小児用のパッドがあれば使用する。なければ、大人用を代用する。 |

# 心肺蘇生法（乳児）１歳未満

１１９番通報　情報把握

救　急　出　場

叩いたり、呼びかけると手足を動かしたりしますか？呼吸をしていますか？

異物除去も考慮する

はい

呼吸は正常ですか？どのような呼吸か真似てみて下さい

回　復　体　位　等
必要な応急手当指導

救急車が到着するまでに容態が変われば再度連絡して下さい

救急車の誘導依頼

いいえ

他に誰かいますか？

いる → 救急車の誘導依頼

いない

今、お使いの電話は移動できますか？もし移動できるならば患者さんの近くに移動してください。

救急車は向かっていますので、私の言うことをよく聞いて下さい。

あなたは、心肺蘇生法ができますか？

できる

実施して下さい。
（30:2）

できない

胸骨圧迫（心臓マッサージ）の方法を教えます。

まず、硬くて平らな床や畳に仰向けに寝かせて下さい。

胸の真ん中乳首と乳首を結ぶ線より少し足側の胸骨上に指2本を置いて、
胸の厚みの1/3が沈むように垂直（背骨に向かって）に押して下さい。
「1・2・3・4・5　と　このくらいの速さで押してください。」リズムを指導

胸を押した時に反応があればすぐに教えて下さい。

なし

電話は切らずに、救急車が到着するまで続けて下さい。

あり

何らかの応答や仕草があれば、胸骨圧迫（心臓マッサージ）を中止してください。

回　復　体　位　等
必要な応急手当指導

救急車の誘導依頼

# 心肺蘇生法（乳児・1歳未満が対象）口頭指導の詳細

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|---|---|
| 反応の確認 | 患者の足裏を叩いて刺激したり、大きな声でよびかける。何らかの応答や仕草があれば反応があると判断する。 |
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| 異物の確認 | 目で見える異物は注意して取り除く。不用意に患者の口の中に救助者（大人）の指を入れて異物を押し込まないようにする。原則として背部叩打法を指導する。 ＊異物除去が不可能であれば、こだわることなく胸骨圧迫（心臓マッサージ）を指導する。 |
| 人工呼吸 | 気道確保をしたままの状態で、あなたの口を患者の口と鼻より大きく開けて覆いかぶせて、息を吹き込んでください。患者の胸が軽く膨らむ程度で1回1秒ぐらいで2回吹き込んでくださいと指導する。<br>＊人工呼吸については省略が可能。 |
| 胸骨圧迫<br>心臓マッサージ | 胸の真ん中乳首と乳首を結ぶ線より少し足側の胸骨上に指2本を置いて、胸の厚みの1/3が沈むように垂直（背骨に向かって）に押して下さい。<br>「1・2・3・4・5 と このくらいの速さで押してください。」リズムを指導<br>＊1分間に100回のリズムで絶え間ない胸骨圧迫が重要である。 |
| CPR | 胸骨圧迫 「1・2・3・4・5 と このくらいの速さで30回押してください。」と人工呼吸を繰り返すように指導する。 |

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Clinical paper

# Evaluation of telephone-cardiopulmonary resuscitation advice for paediatric cardiac arrest☆

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ABSTRACT

*Introduction:* Telephone-cardiopulmonary resuscitation (CPR) advice aims to increase the quality and quantity of bystander CPR, one of the few interventions shown to improve outcome in cardiac arrest. We evaluated a current paediatric telephone protocol (AMPDS v11.1) to assess the effectiveness of verbal CPR instructions in paediatric cardiac arrest.

*Methods:* Consecutive emergency calls classified by the AMPDS as cardiac arrests in children <8 years old, over an 11 month period, were compared with their corresponding patient report forms (PRFs) to confirm the diagnosis. Audio recordings and PRFs were then evaluated to assess whether bystander CPR was given, and when it was, the time taken to perform CPR interventions, before paramedic arrival.

*Results:* Of the 42 calls reviewed, 19 (45.2%) were confirmed as cardiac arrest. CPR was already underway in two cases (10.5%). Of the remaining callers, 11 (64.7%) agreed to attempt T-CPR, resulting in an overall bystander-CPR rate of 68.4%. The median time to open the airway was 126 s (62–236 s, $n$ = 11), deliver the first ventilation was 180 s (135–360 s, $n$ = 11), and perform the first chest compression was 280 s (164–420 s, $n$ = 9).

*Conclusion:* Although current telephone-CPR instructions improve the numbers of children in whom bystander CPR is attempted, effectiveness is likely to be limited by the significant delays in actually delivering basic life support.



## 1. Introduction

The incidence of paediatric out-of-hospital cardiac arrest is approximately 1/10,000 children per annum,[1,2] equating to approximately 400 infant deaths per year in the UK.[3] Although paediatric cardiac arrest is therefore a relatively uncommon pre-hospital emergency, few other medical emergencies are of greater impact in relation to potential life years lost and the subsequent impact on family members. The paediatric chain of survival comprises four links; the second being early basic life support and the third being early access to emergency medical service (EMS) systems.[4] The effectiveness of the pre-hospital element of paediatric cardiac arrest is therefore key in determining outcome from cardiac arrest.

In the absence of trained medical help, bystander cardiopulmonary resuscitation is encouraged prior to ambulance arrival through delivery of telephone resuscitation instructions. Although paediatric bystander CPR tends to be performed more frequently than in adults, rates no higher than 22.9–32.4%[1,5,6] have been reported. The benefits of bystander CPR for paediatric cardiac arrest are not as well documented as for adults, but the majority of studies, as with adult literature, have shown that bystander CPR is a significant determinant of overall survival,[2,7,6] with one study demonstrating a doubling of paediatric survival rates.[6] Although the prevalence of patients receiving CPR is low, and it is often of poor quality,[8–12] giving verbal instructions by telephone increases both the numbers of patients who receive telephone CPR[13,14] and the quality of the CPR delivered, an independent factor in determining survival.[9,15,16]

With the recognition that early and effective bystander CPR is generally associated with improvement in outcome from paediatric cardiac arrest, it is now routine for EMS systems to give CPR instructions over the telephone (telephone-cardiopulmonary resuscitation, T-CPR) whilst an emergency response vehicle is en route. This aims to encourage the caller to perform CPR and also improve the quality of CPR that is given, particularly for untrained bystanders. Various telephone triage scripts exist to identify the cardiac arrest and give set verbal CPR instructions; in the UK, all but one county use the Advanced Medical Priority Dispatch System (AMPDS) for this purpose.

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Little is know about the ability of telephone scripts to provide effective instruction in cardiopulmonary resuscitation. We have previously examined the delivery of telephone-directed CPR (T-CPR) advice by ambulance call takers for adult cardiac arrest and demonstrated significant delays in the delivery of basic life support interventions, together with poor quality resuscitation. We therefore analysed emergency calls to the Hampshire Division of South Central Ambulance Service, a population of approximately 1.7 million people, of whom 10% are <8 years age, to identify paediatric cardiac arrests in order to ascertain the quality of bystander CPR that results from ambulance call taker-delivered telephone instructions.

## 2. Materials and methods

Emergency calls to the Hampshire division of South Central Ambulance Service NHS Trust involving children ≤8 years age were identified retrospectively over a 12 month period (6 April 2007 and 30 March 2008). The calls were received by accredited and audited call handlers using the Advanced Medical Priority Dispatch System (AMPDS v11.1, Priority Dispatch Inc., Salt Lake City, UT, USA). Through a series of structured questions each call is assigned a diagnostic code. All calls that were assigned a code for an infant (≤1 year) or child (≤8 years) cardiac arrest were reviewed. Call takers are not medically qualified. They are trained to read out a specific script from which they are not allowed to deviate. They do not themselves make any diagnosis of cardiac arrest; call categorisation occurs as a result of answer to questions asked by the call taker and fed into the AMPDS algorithm.

The corresponding patient record form (PRF) completed by the attending ambulance crew was then reviewed to confirm the diagnosis of cardiac arrest. If the ambulance crews' diagnosis concurred with the AMPDS coding of cardiac arrest, the original emergency telephone call recording was evaluated. Patients with an alternative diagnosis were excluded from further analysis. From this data, the age and sex of the child were established, together with details of any bystander CPR already in progress, whether the bystander was trained in CPR, if the cardiac arrest had been witnessed and whether the emergency called was made from a residential location. Ambulance crews making the diagnosis of cardiac arrest were trained to technician and paramedic standards set by the Institute for Healthcare Development. We also reviewed all PRFs for children ≤8 years, irrespective of the AMPDS classification, where the primary diagnosis made by the ambulance crew was 'cardiac arrest'.

During the emergency call, the call handler first obtains the location of the incident and then asks if the patient is conscious and breathing. If the answer to these latter two questions is "no", CPR instructions are provided which are summarised below. (The specific verbal instructions have been detailed in a previous study.[17]) These verbal instructions were based on the 2000 ILCOR resuscitation guidelines.[18] The sequence of instructions given by the ambulance call taker were as follows:

1. Check airway.
2. Check breathing.
3. Start mouth-to-mouth rescue breaths.
4. Check for chest rise with rescue breaths.
5. Start external chest compression.
6. Continue alternate rescue breaths and chest compressions.

The time taken from answering the call to reaching each of these interventions was ascertained by listening to the recording. Each call was assessed to identify any delays in the process or reasons why each component of CPR could not be completed. Where it was clear from the recording (e.g. the bystander calling out the chest compressions, enabling an estimate of timing to be made), the rate of chest compression was recorded. In addition, any delay in establishing the geographical location of the incident or delays passing CPR instructions were also noted.

### 2.1. Ethics approval

According to guidance from the National Patient Safety Agency and National Research Ethics Service, this study constitutes 'clinical audit' which does not require formal research ethics approval. The Clinical Advisory Group of Hampshire Ambulance Service reviewed this study application and subsequently authorised this audit.

### 2.2. Statistical analysis

Data is reported using non-parametric analysis as appropriate.

## 3. Results

During the data collection period (6 April 2007–30 March 2008), a total of 8498 calls involving children ≤8 years age were logged. Of these, 42 calls were classified as paediatric cardiac arrest by AMPDS. During this period, a total of 49 paediatric cardiac arrests were recorded by corresponding patient report forms (PRFs). Corresponding PRFs completed by the ambulance crews confirmed cardiac arrest in 19 (45.2%) of the 42 AMPDS calls classified as cardiac arrest. This constitutes approximately 111 paediatric cardiac arrests per million children ≤8 years age per annum. The diagnosis recorded on all 42 PRFs is summarised in Table 1. Of the 19 confirmed cardiac arrests, the median age was 6.5 months (range 2 weeks–8 years). Ten children (52.6%) were male. The cardiac arrest was witnessed in four calls (21.1%) and 16 calls (84.2%) were made from a home address.

Call categorisation vs. ambulance crew diagnosis is shown in Table 2. Sensitivity and specificity was calculated at http://www.hutchon.net/EPRval.htm (accessed 24 December 2009).

**Table 1**
Summary of paramedic diagnosis on patient report forms for calls classified by AMPDS as cardiac arrest.

| Diagnosis | N | % |
|---|---|---|
| Cardiac arrest | 19 | 45.2 |
| Febrile convulsion | 4 | 9.5 |
| Seizures/convulsions | 3 | 7.1 |
| Respiratory arrest/apnoea | 4 | 9.5 |
| Respiratory problem | 3 | 7.1 |
| Floppy/apnoea/pyrexia | 3 | 7.1 |
| Sudden Infant Death Syndrome (SIDS) | 1 | 2.4 |
| Near drowning | 2 | 4.8 |
| Unwell | 2 | 4.8 |
| Vomit | 1 | 2.4 |
| Total | 42 | 100 |

**Table 2**
Summary of AMPDS categorisation vs. ambulance crew diagnosis (numbers = numbers of cases).

| | AMPDS categorisation | | |
|---|---|---|---|
| | Cardiac arrest | Not cardiac arrest | |
| Diagnosis by ambulance crew | | | |
| Cardiac arrest | 19 | 7 | 26 |
| Not cardiac arrest | 23 | 8449 | 8472 |
| | 42 | 8456 | 8498 |

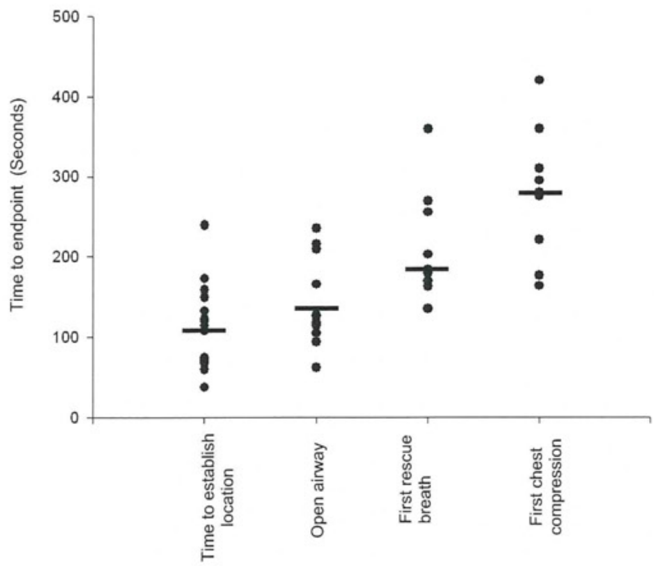


**Fig. 1.** Dot plot showing time to specific endpoints. Median values are shown by horizontal bar.

- Sensitivity = 73.1%.
- Specificity = 99.7%.
- Positive predictive value = 45.2% (95% CI from 31.2% to 60.1%).
- Negative predictive value = 99.9% (95% CI from 99.83% to 99.96%).

### 3.1. Delivery of bystander CPR

Of the 19 cases of confirmed cardiac arrest, CPR was already underway in only two cases (10.5%). Twelve callers (63.2%) attempted CPR with telephone instructions; five of these were healthcare professionals, or individuals with previous CPR training.

In the six calls where CPR was not in progress at the time of answering the emergency call (31.6%), there were several reasons why CPR was not subsequently commenced.

- One child had a 'Do not attempt resuscitation' (DNAR) order.
- Three children were found cold and stiff, the caller stating that the child was beyond help with attempts at CPR being futile.
- Two callers were given no instruction to start CPR by the ambulance call taker. In both cases, the caller's panic not permitting instructions to be conveyed to them. In the second case, the ambulance call taker also wasted time instructing the caller to fetch a neighbour.

### 3.2. Time to specific endpoints

Of the 18 calls with available voice recording, the median time (range) from the call being answered to specific endpoints was as follows:

| | |
|---|---|
| • Time to establish location and patient details ($n$ = 18) | 108 s (38–240 s) |
| • Time to opening airway ($n$ = 11) | 126 s (62–236 s) |
| • Time to first ventilation ($n$ = 11) | 180 s (135–360 s) |
| • Time to first chest compression ($n$ = 9) | 280 s (164–420 s) |

Results are summarised in Fig. 1.

### 3.3. Rate of chest compression

In five children receiving bystander chest compressions prior to arrival of the ambulance crew, the individual delivering compressions counted aloud. The median compression rate was 87 $min^{-1}$ (range 60–100 $min^{-1}$).

**Table 3**
Summary of causes of delays in delivering T-CPR.

| | $N$ | % |
|---|---|---|
| Caller panic | 9 | 50.0 |
| Establishing location/repetition of details | 5 | 27.8 |
| Poor/inadequate instructions from call taker | 3 | 16.7 |
| Caller instructed to fetch neighbour/opening door | 2 | 11.1 |
| Caller needed persuasion to start CPR on cold stiff baby | 2 | 11.1 |
| Child not near phone | 1 | 5.6 |
| Relaying T-CPR instructions through a third party | 1 | 5.6 |

### 3.4. Delays in delivery of resuscitation

The common reasons set out for delays in delivery of T-CPR are summarised in Table 3. Some calls had multiple causes for delays.

The most common reason for delay was caller panic. This either consisted of the caller screaming down the phone and not providing location information, or the caller not being calm enough to speak clearly or listen and respond to T-CPR instructions. Some callers stopped talking to the ambulance call taker altogether due to their panic. Occasionally, delays occurred where the ambulance call taker, having established the location of the incident, asked again for details. Some ambulance call takers wasted time instructing the caller to fetch a neighbour to help, prior to giving instructions for T-CPR.

## 4. Discussion

This is the first study that we are aware of that examines the ability of telephone scripts to promptly and effectively deliver paediatric T-CPR. The results highlight significant delays in actually commencing basic life support, with a median time of 3 min from answering the emergency call to delivery of the first rescue breath and over 4 min to deliver the first external chest compression. These findings are considerably longer than those documented by our previous manikin-based studies. The paediatric manikin study documented 1.5 min to first rescue breath and 2 min to initial external chest compression,[19] whilst the adult study documented 2 min to first rescue breath and 2.5 min to initial external chest compression.[20] The longer times taken in actual clinical cases is most likely due to more time being spent to establish the caller's address but primarily a more calm scenario with telephone instructions being followed more effectively. The median rate of external chest compression of 87 $min^{-1}$ is slower than that documented with the manikin study, which documented a rate of 95 $min^{-1}$. Adult studies have shown that when the call taker counts the chest compression rate out aloud, the rate of chest compression improves and this may be something to consider for future telephone scripts.[21]

It is encouraging that provided the caller believes the child is not beyond help, almost all callers are prepared to attempt bystander CPR if they are given telephone instructions. The greatest challenge in doing this is overcoming the by the panic of the caller. Refinement of existing scripts and use of modern technology to pinpoint calls without having to ask the caller for exact location may also reduce the delays occurring at this initial stage of the call.

Delays to delivery of the first rescue breath and first chest compression are significant, but highlight the difficulties of using a script delivered by non-medically qualified call takers to establish the diagnosis. We have previous shown that delivery of quick and effective CPR instructions at simulated paediatric cardiac arrest is difficult and although subtle changes to wording may improve the efficacy of this method to some extent, the most challenging factor that precludes effective delivery is the caller's panic.

Since this study was conducted, newer AMPDS instructions have been introduced, but there are no major differences in the instruction sequence or wording. We therefore believe that performance of the current telephone script is likely to be similar. The CPR advice provided by the ambulance call taker in this study was consistent with the European Resuscitation Council Guidelines 2000 for basic paediatric life support.[17] Changes to the resuscitation guidelines have also been incorporated into more recent scripts, primarily relating to the compression:ventilation ratio (30:2) but again, we do not believe that this modified protocol would affect current performance significantly.

This study highlights the difficulties of using a telephone script to correctly identify cardiac arrest. Although achieving a specificity of 99.7%, sensitivity was only 73.1%. The commonest misdiagnosis (Table 1) was the post-ictal state following a febrile convulsion, with the absence of breathing and lack of signs of life being interpreted, quite reasonably by the telephone script, as a cardiac arrest. These children are unlikely to have come to harm by a short period of bystander CPR and it is difficult to see how this group could safely be distinguished from true cardiac arrest by the use of a telephone script alone.

In summary, this study highlights the difficulties in diagnosing cardiac arrest using a telephone script and subsequently delivering effective and timely resuscitation instructions. Significant delays have been documented to occur which may be reduced by further refinement of the scripts, particularly in relation to establishing the location of the incident.

## Conflict of interest

None to declare.

## Acknowledgements

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CLINICAL RESEARCH

# Public access defibrillation improved the outcome after out-of-hospital cardiac arrest in school-age children: a nationwide, population-based, Utstein registry study in Japan

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**Aims** The purpose of this study was to determine whether implementation of public access defibrillation (PAD) improves the outcome after out-of-hospital cardiac arrest (OHCA) in school-age children at national level.

**Methods and results** We conducted a prospective, nationwide, population-based Japanese Utstein registry study of consecutive OHCA cases in elementary and middle school children (7–15 years of age) who had a bystander-witnessed arrest of presumed cardiac origin during 2005–09 and received pre-hospital resuscitation by emergency responders. The primary endpoint was a favourable neurological outcome 1 month after an arrest. Among 230 eligible patients enrolled, 128 had ventricular fibrillation (VF) as an initial rhythm. Among these 128 patients, 29 (23%) children received a first shock by a bystander. Among these 29 patients, the proportion of the favourable neurological outcome after OHCA was 55%. During the study period, the proportion of patients initially shocked by a bystander among eligible patients increased from 2 to 21% ($P = 0.002$ for trend). The proportion of patients with a favourable neurological outcome after OHCA increased from 12 to 36% overall ($P = 0.006$). The collapse to defibrillation time was shorter in bystander-initiated defibrillation when compared with defibrillation by emergency responders ($3.3 \pm 3.7$ vs. $12.9 \pm 5.8$ min, $P < 0.001$), and was independently associated with a favourable neurological outcome after OHCA [$P = 0.03$, odds ratio (OR) per 1 min increase, 0.90 (95% confidence interval 0.82–0.99)]. A non-family member's witness was independently associated with VF as the initial rhythm [$P < 0.001$, OR 4.03 (2.08–7.80)].

**Conclusion** Implementation of PAD improved the outcome after OHCA in school-age children at national level in Japan.

**Keywords** Cardiopulmonary resuscitation • Sudden unexplained death • School health • Public access defibrillation • School-age children

## Introduction

Sudden cardiac death in elementary and middle school children is a rare but tragic event, which has tremendous impact on the family, school, communities, and health-care providers, and which may be relevant to cardiopulmonary resuscitation (CPR)/automated external defibrillator (AED) programmes in the public environment surrounding these children.[1,2] Recently, implementation of public

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## What's new?

- This is the first population-based study, which specifically addressed the impact of public access defibrillation on the outcome of out-of-hospital cardiac arrests (OHCAs) in elementary and middle school children.
- Among 230 eligible patients, 128 (56%) had ventricular fibrillation (VF) as an initial rhythm. Among these 128 patients, 29 (23%) children received a first shock by a bystander. Among these 29 patients, the proportion of the favourable neurological outcome after OHCA was 55%.
- During the study period 2005–09, the proportion of patients initially shocked by a bystander among eligible patients increased from 2 to 21%. The proportion of patients with a favourable neurological outcome after OHCA increased from 12 to 36% overall.
- A non-family member's witness was independently associated with VF as the initial rhythm. The collapse to defibrillation time was independently associated with a favourable neurological outcome, the survival at 1 month, and the pre-hospital return of spontaneous circulation after OHCA.

access defibrillation (PAD) improved outcomes among adults after out-of-hospital cardiac arrest (OHCA) in public locations, by reducing the time interval from the patient's collapse to defibrillation.[3–6] However, the impact of PAD on the outcome after OHCA in such school-age children was unclear. This question is challenging two-fold. First, paediatric patients of different ages have diverse aetiologies of OHCA; relatively poor survival has been reported in this heterogeneous group of patients.[7,8] The reported incidence of ventricular fibrillation (VF) as an initial rhythm in paediatric OHCA is lower than that reported in adults, and the effectiveness of early defibrillation programmes even for paediatric patients in VF arrest has been questioned.[7,8] Secondly, although school-age children are reported to spend a large part of their active daytime in public locations,[9] it is uncertain whether PAD programme, if any, would be effective for ordinary children in the children's public environment, including schools.[2,9–11] Recently, VF was found to be present in a higher percentage of high school-age athletes with sudden arrest, and recent small series have noted improved survival when early defibrillation with CPR was provided for such patients in high schools.[11–13] However, the limited deployment of AED devices in elementary and middle schools, and other public locations, a small sample size of OHCA in this age population in local studies, and the lack of an appropriate reporting system of OHCA, may have hampered any investigations involving the epidemiological basis of the benefit of PAD for OHCA in such school-age children.[11,12,14,15]

In Japan in July 2004, the Ministry of Health, Labour and Welfare approved AED use by citizens. By 2009, the number of AED devices in public places increased to 203 924 (106.6/100 000 population).[16,17] Of note, up to 28.9% of public access AED devices in Japan were placed in schools; by 2009, AEDs were placed in 72% of elementary schools and 89.8% of middle schools.[18,19] In January 2005, the Fire and Disaster Management Agency of Japan launched a prospective, nationwide, population-based, Utstein-style registry involving consecutive OHCA victims in all the age groups.[20] A recent study, using the Utstein registry database, demonstrated that there was a temporal increase in public access AED application and improved outcomes after OHCA in adults at the national level.[20] However, the impact of the national PAD programme on outcomes of OHCA in elementary and middle school children has not been reported. We therefore investigated whether PAD may have an impact on the outcome after OHCA in such school-age children at the national level, by using the Japanese Utstein registry database.[20,21]

# Methods

## Study design

The All-Japan registry of the Fire and Disaster Management Agency of Japan is a prospective, nationwide, population-based registry of OHCA, which is based on the standardized Utstein style, as reported in detail previously.[20,21] Briefly, this cohort enrolled all consecutive patients who suffered OHCA all over Japan, and were treated by emergency medical service (EMS) personnel and transported to hospitals. Specific enrolment process was described in Supplementary material online, Supplementary methods.[20,21] Among these patients, who had OHCA during January 2005–December 2009, we identified eligible patients who were 7–15 years of age, because we would include school-age students in compulsory education, which corresponds to the elementary and middle schools in Japan: high school students were thereby excluded. We identified those school-age victims with bystander-witnessed OHCA of presumed cardiac origin occurring during the entire day. Cardiac arrest was defined as the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation.[22–24] The arrest was presumed to be of cardiac origin unless it was caused by non-cardiac (respiratory disease, malignant tumours, and central nervous system disorders), external (trauma, hanging, drowning, drug overdose, and asphyxia) , or any other non-cardiac factors.[22–24] The data form was filled out by the EMS personnel in cooperation with the physicians in charge of the patients, and the data were integrated into the registry system on the database server. The working group for All-Japan Utstein registry designed the study protocol; collected and managed the data; and the authors analysed the data and wrote the manuscript. The protocol for analyses was approved by the Ethics Committee of Mie University Graduate School of Medicine.

## Study setting

Emergency medical service and training system in Japan was previously reported in detail.[20,21] Briefly, Japan has an area of ~378 000 km$^2$, and its population was 127 million, including 3 666 839 male and 3 496 405 female 7–12-year-old children (elementary school students), and 1 871 134 male and 1 780 230 female 13–15-year-old children (middle school students) in 2005.[25] Placement of AEDs in public locations was driven by either public or private initiatives.[17] The cumulative number of public access AEDs, excluding those in medical facilities and EMS institutions, as estimated from sales of AEDs, increased from 9906 to 203 924 during the 5-year study period (see Supplementary material online, *Table*).[16] A total of 96.5% of public access AEDs are located in public locations (28.9% in schools, 20.6% in workplaces, 8.8% in nursing homes, 5.7% in sports facilities, 4.8% in cultural facilities, 2.6% in public transportation facilities, and 25.1% in other public locations), 1.4% in residential areas, and 2.1% in others.[18] From 2007 to 2009, the percentage of elementary or middle schools equipped with at least one AED device increased from 18.1 to 72.9% in elementary schools and from 38.3 to 89.8% in middle schools (see Supplementary material online, *Table*).[19] School teachers and other staff were trained in CPR programmes by EMS providers or other instructors, under the guidance of local school boards, in which paediatric and adult PADs were generally recommended for children at 7 years of age and older, respectively, in accordance with the Japanese CPR guidelines.[26] In Japan, ~1.4–1.5 million citizens per year participated in the CPR/AED training programmes, generally provided by local fire departments.[27]

## Data collection

Procedure of data collection was described previously.[20,21] Briefly, registry data were prospectively collected in accordance with the Utstein-style reporting guidelines for OHCA, which is a standardized form (uniform definitions, terminology, and recommended data sets) for clinical investigators to report human resuscitation studies.[20,21,23,24] Specific data sets and data collecting process were described in Supplementary material online, Supplementary methods.[20,21,23,24] In the present Japanese Utstein reporting system, a patient initially shocked by a bystander was defined as one in which a public access AED was used and the shock was delivered; if the public access AED was applied but the shock was not delivered, the patient was not included in this category.[20,21] In this analysis, an OHCA witnessed by non-family members was presumed to be an event in a public location, because of a lack of data with respect to specific locations in the registry; when a bystander delivered shocks with an AED, the initial rhythm of the patient was regarded as VF, including pulseless ventricular tachycardia.

## Endpoints

The primary endpoint was survival at 1 month with minimal neurological impairment, which was defined as a Glasgow–Pittsburg cerebral performance category of 1 (good performance) or 2 (moderate disability).[23,24] Secondary endpoints were survival at 1 month and return of spontaneous circulation (ROSC) before arrival at the hospital.

## Statistical analysis

The age-stratified annual incidence of OHCA was calculated with the use of 2005 census data.[25] Continuous variables between two groups were assessed by the unpaired *t*-test. Trends in categorical and continuous variables were analysed with the use of univariate regression models and linear tests, respectively, in overall and subgroups of eligible patients, determined by the relation of bystanders to the victims (family or non-family member). The planned subgroup analysis was intended to determine the impact of PAD on trends in outcome parameters of arrest in presumed public locations (non-family member-witnessed arrests) in comparison with the non-public location arrest (family member-witnessed arrests). Univariate and multivariable logistic regression analyses were performed to assess the factors associated with VF as the initial rhythm, and outcome parameters. Adjusted and unadjusted odds ratios with their 95% confidence intervals and *P* values were reported. Potential confounding factors adjusted for VF as the initial rhythm included the calendar year, the age, gender, the relation of the bystander to the patient (family or non-family member), the type of CPR initiated by a bystander (compression-only or conventional CPR), and the time from the witnessed collapse to the EMS arrival, in accordance with previous reports.[20,21,28] Potential confounding factors for outcome parameters included VF as an initial rhythm, bystander's AED use at the first shock, and the time from the witnessed collapse to the first shock, in addition to the potential confounders for VF, in accordance with previous reports.[20,21,28] All statistical analyses were performed with the use of the SPSS statistical package, version 16.0J (SPSS). Data were reported as mean ± standard deviation. All tests were two-tailed, and *P* values of $<0.05$ were considered to indicate statistical significance.

# Results

Among 2072 OHCA children, 522 were of presumed cardiac origin; 230 of 522 arrests were witnessed by bystanders (*Figure 1*). Among a total of 230 eligible patients, 128 (56%) children had VF as the initial rhythm. Among these 128 patients, 29 (23%) children received a first shock by bystanders using a public access AED before the arrival of EMS personnel and 96 (75%) children received a first shock by EMS personnel (32 with a monophasic and 64 with a biphasic defibrillator). In addition, among 102 patients without VF as the initial rhythm, none received bystander's defibrillation, but 13 (13%) received a shock by EMS personnel following CPR. Among 128 children with VF as the initial rhythm, 53 (41%) survived with a favourable neurological outcome, 67 (52%) survived 1 month after the arrest, and 55 (43%) had pre-hospital ROSC. Among the subset of 29 school-age children with OHCA who received initial AED shock by bystanders, 16 (55%) survived with favourable neurologic outcome, 19 (66%) survived 1 month after the arrest and 19 (66%) had prehospital ROSC. Among 102 patients without VF as the initial rhythm, 8 (8%) survived with favourable neurological outcome, 15 (15%) survived 1 month after the arrest and 11 (11%) had pre-hospital ROSC. The time interval from collapse to the initiation of CPR was shorter in bystander-initiated CPR than EMS-initiated CPR ($3.2 \pm 4.9$ vs. $8.9 \pm 6.8$ min, $P < 0.001$). The interval from collapse to the initiation of AED use was shorter in bystander-initiated AED use than EMS-initiated one ($3.3 \pm 3.7$ vs. $12.9 \pm 5.8$ min, $P < 0.001$). Clinical and outcome parameters in the overall, family and non-family member witnessed arrests were reported in *Table 1*. The population-based age-stratified incidence of bystander-witnessed OHCA of presumed cardiac origin in children was constant during the study period (see Supplementary material online, *Table*).

## Trends in clinical and outcome parameters

During the study period (*Table 2*), the proportion of patients initially shocked by a bystander's AED among total patients increased from 2% in 2005 to 21% in 2009 ($P = 0.002$). Such a temporal increase was observed in non-family member-witnessed arrests, from 4% in 2005 to 37% in 2009 ($P = 0.001$), but not in family member-witnessed arrests. The collapse to AED time tended to become shorter only in non-family member-witnessed arrests, from 11.1 min in 2005 to 8.3 min in 2009 ($P = 0.07$). The proportion of any other categorical and continuous variables investigated in either subgroup of patients did not change significantly (see Supplementary material online, *Appendix 1*). As the outcome parameters (*Figure 2*), the proportion of patients with a favourable neurological outcome among total patients increased from 12% in 2005 to 36% in 2009 ($P = 0.006$). Such a temporal improvement

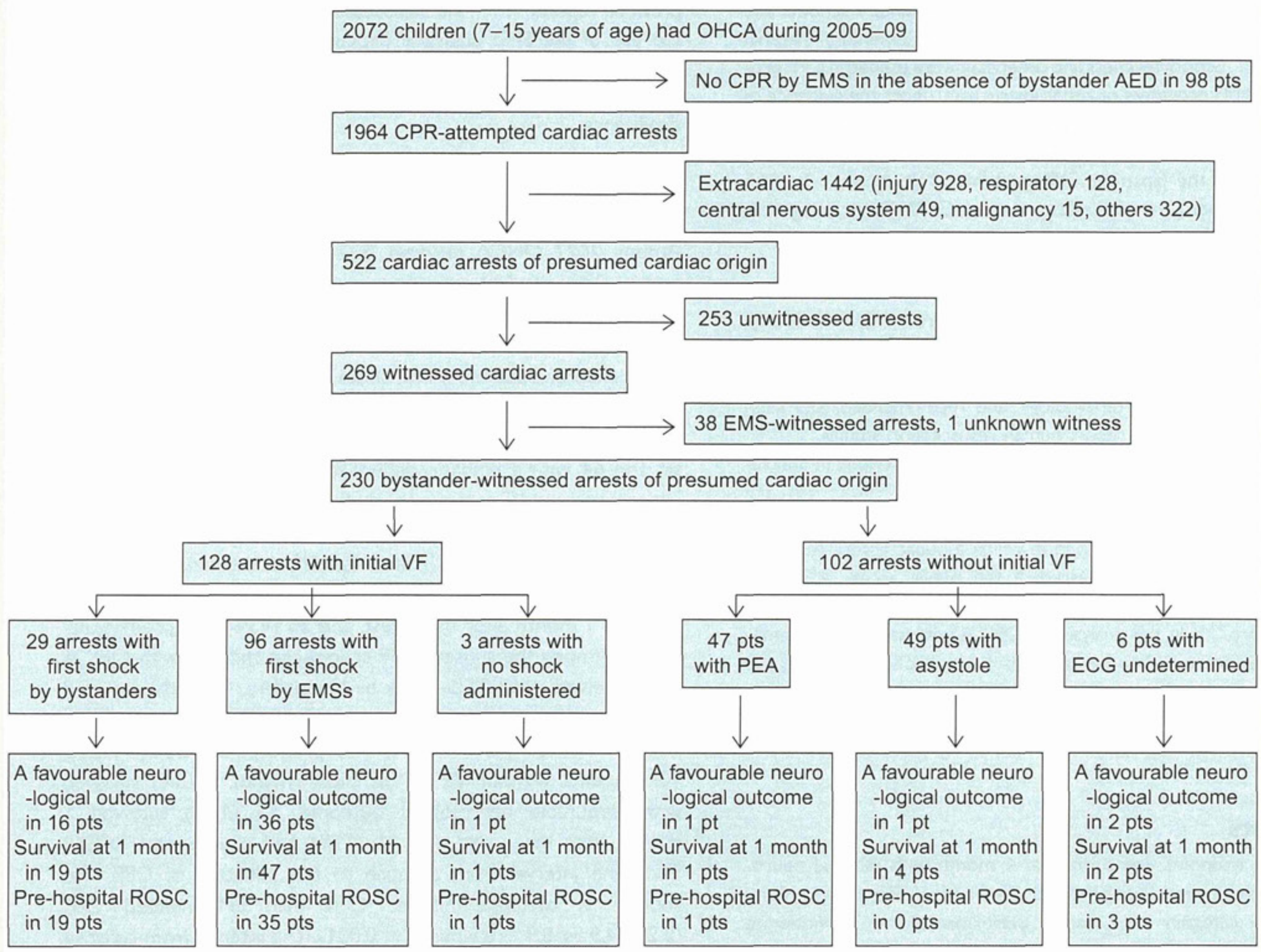


**Figure 1** Study profile. OHCA, out-of-hospital cardiac arrest; CPR, cardiopulmonary resuscitation; EMS, emergency medical service; AED, automated external defibrillator; VF, ventricular fibrillation; PEA, pulseless electrical activity; ECG, electrocardiography; ROSC, return of spontaneous circulation; pts, patients.

was observed only in non-family member-witnessed arrests, from 9% in 2005 to 53% in 2009 ($P = 0.001$). The proportion of survival at 1 month after OHCA ($P = 0.008$) and ROSC before arrival at the hospital ($P = 0.046$) increased only in non-family member-witnessed arrests, from 17 and 17% in 2005 to 53 and 42% in 2009, respectively. Trends in specific values in all the clinical and outcome parameters investigated in overall and subgroups of patients were reported (see Supplementary material online, *Appendix 1*).

## Multivariable analysis

In multivariable analysis (*Table 3*), a non-family member's witness [$P < 0.001$, adjusted odds ratio (OR) 4.03 (2.08–7.80)] was independently associated with the presence of VF as the initial rhythm. The collapse to AED time, either by a bystander or an emergency responder [$P = 0.03$, OR per 1 min increase, 0.90 (0.82–0.99)], and female gender [$P = 0.008$, 3.20 (1.35–7.56)] were independently associated with a favourable neurological outcome. The collapse to AED time was the only variable independently associated with the survival at 1 month [$P = 0.045$, 0.92 (0.85–0.99)] and pre-hospital ROSC [$P = 0.001$, 0.82 (0.73–0.92)]. Results of univariate analysis were reported in the see Supplementary material online, *Appendix 2*.

# Discussion

Although the epidemiological data related to the impact of disseminating PAD programmes on OHCA in elementary and middle school children were limited,[7,8] the present Utstein registry study would supply evidence supporting that implementation of PAD programmes increases the likelihood of early defibrillation by bystanders, and improves the outcome after OHCA in such school-age children. These findings may underscore the benefit of PAD in the prevention of sudden cardiac death in school-age children.

**Table 1** Clinical and outcome parameters

| Parameters | Total (*n* = 230) | Family witnessed (101) | Non-family witnessed (129) |
|---|---|---|---|
| Age, years of age | 12.2 ± 2.5 | 11.3 ± 2.7 | 12.8 ± 2.1 |
| Male gender, *n* (%) | 145 (63) | 63 (62) | 82 (64) |
| Ventricular fibrillation, *n* (%) | 128 (56) | 37 (37) | 91 (71) |
| CPR initiated by bystanders, *n* (%) | 161 (70) | 55 (55) | 106 (82) |
| Conventional CPR, *n* (%) | 102 (64) | 30 (55) | 72 (69) |
| Collapse to CPR time (min) | 4.9 ± 6.1 | 5.3 ± 6.3 | 4.6 ± 6.0 |
| Shock initiated, *n* (%) | | | |
| by bystanders | 29 (13) | 2 (2) | 27 (21) |
| by EMS | 109 (47) | 38 (38) | 71 (55) |
| Collapse to AED time (min) | 10.9 ± 6.7 | 13.1 ± 7.0 | 10.0 ± 6.4 |
| Collapse to EMS arrival (min) | 34.6 ± 17.2 | 35.0 ± 16.5 | 34.3 ± 17.7 |
| Favourable neurological outcome, *n* (%) | 63 (27) | 15 (15) | 48 (37) |
| Survival at 1month, *n* (%) | 84 (37) | 22 (22) | 62 (48) |
| Prehospital ROSC, *n* (%) | 66 (29) | 20 (20) | 46 (36) |

Favourable neurological outcome denotes cerebral performance category 1 or 2 at 1 month.
Conventional CPR indicated chest compression with rescue breathing, as a type of bystander-initiated CPR. Percentages were calculated on the basis of the available data in overall or each subgroup of arrests (family or nonfamily witnessed). Plus–minus values are means ± SD.
CPR, cardiopulmonary resuscitation; EMS, emergency medical service; AED, automated external defibrillator; ROSC, return of spontaneous circulation.

**Table 2** Trends in clinical parameters

| Variables | 2005 | 2006 | 2007 | 2008 | 2009 | *P* value for trend |
|---|---|---|---|---|---|---|
| Type of bystanders, (*n*) | | | | | | |
| Total | 41 | 46 | 51 | 48 | 44 | |
| Family member | 18 | 18 | 21 | 19 | 25 | 0.27 |
| Non-family member | 23 | 28 | 30 | 29 | 19 | |
| CPR initiated by bystanders, *n* (%) | | | | | | |
| Total | 26 (63) | 33 (72) | 36 (72) | 37 (77) | 29 (66) | 0.65 |
| Family member | 8 (44) | 9 (50) | 12 (60) | 12 (63) | 14 (56) | 0.35 |
| Non-family member | 18 (78) | 24 (86) | 24 (80) | 25 (86) | 15 (79) | 0.90 |
| Shock initiated by bystanders, *n* (%) | | | | | | |
| Total | 1 (2) | 1 (2) | 10 (20) | 8 (17) | 9 (21) | 0.002 |
| Family member | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 2 (8) | 0.99 |
| Non-family member | 1 (4) | 1 (4) | 10 (33) | 8 (28) | 7 (37) | 0.001 |
| Shock initiated by EMS, *n* (%) | | | | | | |
| Total | 18 (44) | 24 (52) | 26 (51) | 19 (40) | 22 (50) | 0.94 |
| Family member | 6 (33) | 3 (17) | 10 (48) | 7 (37) | 12 (48) | 0.14 |
| Non-family member | 12 (52) | 21 (75) | 16 (53) | 12 (41) | 10 (53) | 0.22 |
| Collapse to AED time (min) | | | | | | |
| Total | 11.8 ± 4.8 | 12.5 ± 5.4 | 10.4 ± 7.2 | 10.2 ± 6.2 | 10.3 ± 8.4 | 0.22 |
| Family member | 13.5 ± 7.2 | 14.3 ± 4.6 | 13.3 ± 4.4 | 12.7 ± 3.0 | 12.6 ± 10.3 | 0.71 |
| Non-family member | 11.1 ± 3.2 | 12.2 ± 5.5 | 9.2 ± 7.8 | 9.4 ± 6.8 | 8.3 ± 5.9 | 0.07 |

Percentages were calculated on the basis of the available data in overall or each subgroup of arrests (family or non-family witnessed) in the respective year. Plus-minus values are means ± SD.
CPR, cardiopulmonary resuscitation; EMS, emergency medical service; AED, automated external defibrillator.

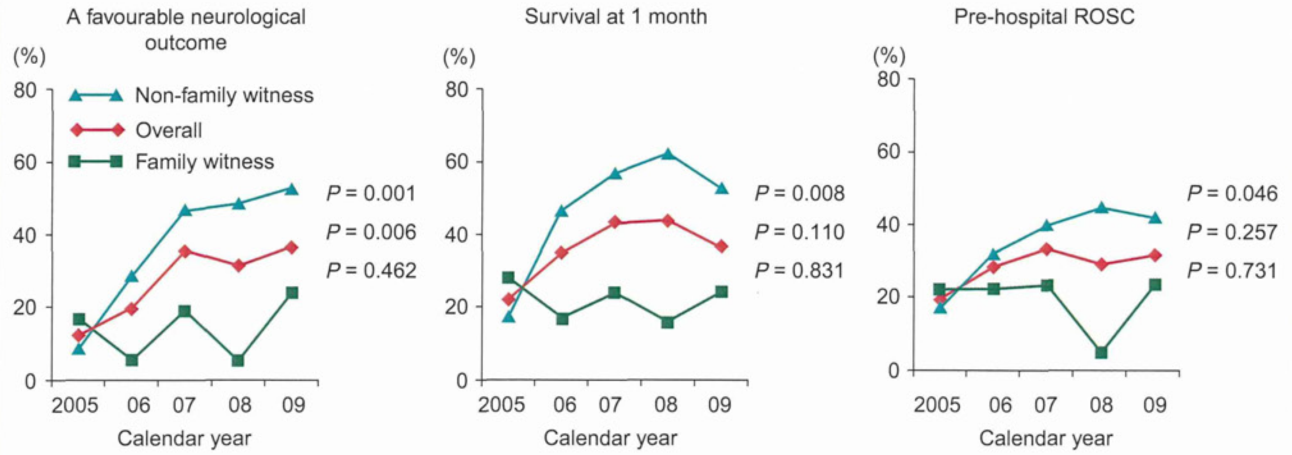


**Figure 2** Trends in outcome parameters in arrests, by the relationship of a bystander to the victim. P values are for trend; ROSC, return of spontaneous circulation.

**Table 3 Multivariable analyses of factors associated with ventricular fibrillation as the initial rhythm and outcome parameters**

| Variable | Ventricular fibrillation | Favourable neurological outcome | Survival at 1 month | Pre-hospital ROSC |
|---|---|---|---|---|
| | Adjusted OR (95% CI) | Adjusted OR (95% CI) | Adjusted OR (95% CI) | Adjusted OR (95% CI) |
| Year (per 1-year increase) | 1.09 (0.87–1.37) | 1.19 (0.87–1.63) | 0.97 (0.73–1.30) | 0.80 (0.58–1.10) |
| *P* value | 0.46 | 0.29 | 0.86 | 0.17 |
| Age≥13 years | 1.83 (0.96–3.48) | 1.79 (0.76–4.20) | 1.60 (0.72–3.54) | 1.60 (0.67–3.80) |
| *P* value | 0.07 | 0.18 | 0.25 | 0.29 |
| Female gender | 0.76 (0.39–1.47) | 3.20 (1.35–7.56) | 1.80 (0.79–4.10) | 2.17 (0.91–5.19) |
| *P* value | 0.41 | 0.008 | 0.16 | 0.08 |
| Non-family witnessed | 4.03 (2.08–7.80) | 1.53 (0.58–4.03) | 1.68 (0.70–4.02) | 0.86 (0.32–2.29) |
| *P* value | <0.001 | 0.39 | 0.27 | 0.76 |
| CPR | | | | |
| Not bystander-initiated | reference | reference | reference | reference |
| Bystander-initiated | | | | |
| Conventional | 0.76 (0.35–1.65) | 1.01 (0.34–3.00) | 1.24 (0.45–3.43) | 0.90 (0.29–2.78) |
| *P* value | 0.49 | 0.98 | 0.68 | 0.86 |
| Compression only | 0.79 (0.34–1.83) | 1.55 (0.51–4.71) | 1.08 (0.38–3.06) | 1.77 (0.58–5.46) |
| *P* value | 0.58 | 0.44 | 0.88 | 0.32 |
| Collapse–EMS time (per 1 min increase) | 0.99 (0.97–1.37) | 1.00 (0.98–1.03) | 1.00 (0.98–1.03) | 1.01 (0.99–1.04) |
| *P* value | 0.30 | 0.74 | 0.89 | 0.33 |
| Ventricular fibrillation as the initial rhythm | | 2.03 (0.43–9.46) | 1.30 (0.34–4.91) | 0.76 (0.18–3.20) |
| *P* value | | 0.37 | 0.70 | 0.71 |
| Bystander's AED | | 0.49 (0.12–2.02) | 0.59 (0.15–2.23) | 0.61 (0.14–2.76) |
| *P* value | | 0.32 | 0.43 | 0.53 |
| Collapse–AED time (per 1-min increase) | | 0.90 (0.82–0.99) | 0.92 (0.85–0.99) | 0.82 (0.73–0.92) |
| *P* value | | 0.03 | 0.045 | 0.001 |

Favourable neurological outcome denotes cerebral performance category 1 or 2 at 1 month.
OR, odds ratio; ROSC, return of spontaneous circulation; EMS, emergency medical service; CPR, cardiopulmonary resuscitation; AED, automated external defibrillator.

## Impact of public access defibrillation on out-of-hospital cardiac arrest in school-age children

Between 2005 and 2009 in Japan, there was a remarkable increase in the availability of AED in public spaces surrounding school children, including schools.[16–19] During this period, there was an increase in the proportion of OHCA in which the victim was initially shocked by a bystander, and this was temporally associated with an improvement in the neurological outcome in children with OHCA. In subgroup analyses, (i) temporal trends in these parameters were evident in non-family member-witnessed arrests, but not in family member-witnessed arrests, (ii) similar trends in secondary outcome parameters were observed in non-family member-witnessed arrests, and (iii) trends in other clinical parameters were not affected in either subgroup of patients during the same period. Therefore, trends in relevant variables, together with multivariable analysis data, consistently support that introduction of PAD programmes would increase the likelihood of early defibrillation by bystanders, and improve the outcomes of school-age children after public location arrest. Such an impact of PAD on OHCA in school-age children is consistent with that reported in adults.[20] In an adult study ($\geq$18 years of age) by using the same Japanese Utstein registry data during 2005–07, 32% of patients with bystander-witnessed OHCA of presumed cardiac origin with initial rhythm of VF who received bystander AED shock delivery had a favourable neurological outcome.[20] In the present study during the corresponding years 2005–07 (data not shown), 58% (7/12) of children who received bystander-initiated shock had a favourable neurological outcome. In other adult studies, the survival rate of OHCA patients initially shocked by a bystander was ~60%.[3,4,6,13] Thus, the survival to 1 month with good neurological outcome of school-age children who experience witnessed OHCA with bystander CPR and AED shock delivery appears to equal or surpass that reported in adults. The more favourable outcome in this paediatric population may result from the higher rate of bystander CPR, and the shorter collapse to CPR and collapse to AED shock delivery intervals than those observed in adults with OHCA during the same period in Japan. This may be explained in part by factors in the school environment, such as constant visual observation of the children and focused training of teachers and staff.

## Frequency of ventricular fibrillation as the initial rhythm in out-of-hospital cardiac arrest in school-age children

The frequency of VF in OHCA in children has been debated for a decade, and has been negatively influenced by the young age ($<$1 year of age), and traumatic and respiratory aetiologies.[7,8,14,15] In the present study, as high as 56% of bystander-witnessed arrests of presumed cardiac origin in school-age children were associated with VF. This is consistent with the results in local studies (in King county of USA, and in a province of the Netherlands), in which the frequency of VF has been positively associated with the advanced age ($\geq$8 years of age), witnessed arrest, and cardiac aetiology, and a half of arrest patients had an initial rhythm of VF among adolescents aged 13–18 years with witnessed arrest.[11,29] In our study, we could further demonstrate that the non-family member-witnessed arrest was independently associated with VF as the initial rhythm, which is consistent with the results in an adult study.[28] The relatively low proportion of initial VF in adolescent OHCA in ROC study may be related to the difference of witness status, aetiology, and the reporting system.[14] The present study suggests that the relatively high proportion of initial VF in bystander-witnessed OHCAs of presumed cardiac origin in public locations in school-age children may confer an epidemiological basis for early defibrillation in this age population.

## Limitations

Several limitations could be acknowledged in this study, in addition to those, as described previously.[20,21] First, the proportion of OHCA patients in schools among total eligible samples is unknown, because of the lack of data with respect to school as a specific location in the registry. Secondly, there might be unmeasured confounding factors (i.e. quality of bystander's CPR) that might influence the association between bystander's defibrillation and outcomes. Thirdly, information on in-hospital treatment (ie, hypothermia) is unavailable, which might affect survival after OHCA. Fourthly, it is unknown whether the present information can be generalized to other communities with different emergency response programmes at schools and other public locations surrounding children,[18,19] or different EMS systems.[20] Fifthly, the present investigation is not a cost-effectiveness analysis, although a previous study of cardiac arrests in high schools indicated that PAD may be cost-effective in schools.[12] Sixthly, specific data on the scope of the budgetary barriers and logistic issues (i.e. the locations of AED placement, training schedule for teachers) in implementing and refining AED/CPR programmes at the national level in Japan is unavailable.[17]

# Conclusions

Although the impact of PAD has been largely elusive in overall children of different ages after etiologically diverse OHCAs in their public environmnent,[7,8] the present study would supply evidence which could dissect an epidemiological basis of the benefit of PAD in school-age children after bystander-witnessed OHCA of presumed cardiac origin. We believe that these findings are relevant to medical emergency response and CPR/AED programmes in the public environment surrounding school-age children.[1,2]

# Supplementary material

Supplementary material is available at *Europace* online.

## Acknowledgement

We thank the emergency medical personnel and participating physicians in Japan, and the Fire and Disaster Management Agency and Institute for Fire Safety and Disaster Preparedness of Japan, for generously gifting their Utstein database.

**Conflict of interest:** none declared.

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平成24年度厚生労働科学研究費補助金
循環器疾患・糖尿病等生活習慣病対策総合研究事業
循環器疾患等の救命率向上に資する
効果的な救急蘇生法の普及啓発に関する研究
坂本班 第二回 班会議

# 小児・乳児の救急蘇生法の効果的普及に関する研究

東京都立小児総合医療センター 救命・集中治療部 集中治療科
国立成育医療研究センター 研究所 成育政策科学研究部
清水直樹
Paediatric Resuscitation Study Group: **PResS group**

## H24 研究協力者

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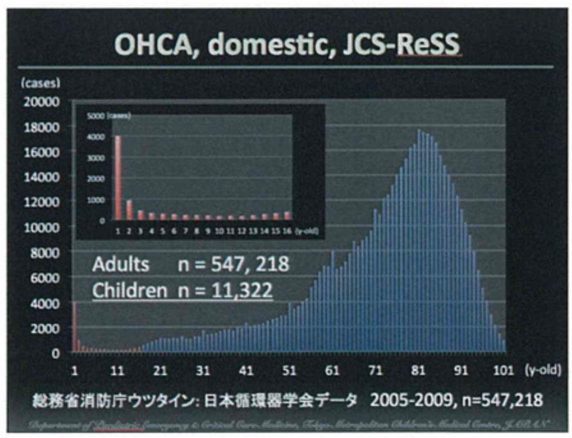
– 六車 崇　国立成育医療研究センター
– 金子哲二　東京都立小児総合医療センター 臨床治験科 （解析担当）

## H24 研究概要

- ガイドライン2010を踏まえた小児救急蘇生法の効果的普及について研究する。小児院外心停止の半数は乳児であり、小児一次救命処置(PBLS)の市民への普及が促進される必要がある。AED適応が乳児年齢にまで広がったことをうけ、乳児に対するAEDをふくめた小児病院前救護等にかかる研究が求められ、新たな小児救急蘇生法の効果的普及のための政策提言につなげる。(新田・六車)
- 学童の効果的救命を指向したAED適正配置について研究する。学校内心停止の疫学調査等をふくめた先行研究結果をもとに、わが国特有の学校心臓検診結果の有機的活用、家庭でのAEDホームユースについての政策提言、ならびに学校へのAED適正配置についての科学的根拠にもとづく政策提言と関連諸学会への働きかけにつなげる。(太田・三谷)




## 学童

背景研究
科研計画

## H24 研究計画

- 学校内心停止の疫学調査等をふくめた先行研究結果をもとに、本研究を進める。学校心臓検診結果を地域集約してAEDの学校適正配置をすすめ、学校内設置位置の適正化にかかる提言も行う。 AEDホームユースの頻度と効能の全国調査も行い、その適応についても検討する。
- 学校心臓検診結果に立脚する学校・家庭におけるAED適正配置と、転帰調査からのフィードバックをふくめた政策提言につなげる。
  – 小・中学校就学児童の小児院外心停止症例(旧 坂本班との接点 ・ 小児ECMO/PCPSレジストリとの接点)全国集計と学校心電図検診データとの突合 (小児循環器学会修練施設)

## 学校心停止にかかる研究

- Mitani, et al
- Nishiuchi, et al
  - 学校における心停止：大阪府における頻度とその予後, JAAM 2009
    - 学校における小児心停止の約半数が VF/VT
  - 学校における心停止：効果的なMedical Emergency Response Plan策定の方策, JAAM 2011
  - Incidence, Outcome, and Characteristics of Cardiac Arrest at Schools, ReSS 2011

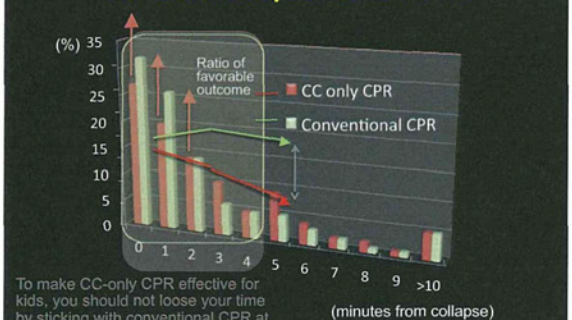
## Results from Children Witnessed by Citizens Started ByCPR Promptly

ReSS 2012
Shimizu
JCS-ReSS

| | All Children | | | Excluding Infants | | |
|---|---|---|---|---|---|---|
| | CC only CPR | Conventional CPR | Adjusted * OR (95%CI) | CC only CPR | Conventional CPR | Adjusted * OR (95%CI) |
| Within 1 min | 20/155 | 33/233 | 1.02 (0.48–2.16) | 17123 | 28/159 | 0.93 (0.41-2.12) |
| Within 2 min | 28/271 | 58/405 | 0.75 (0.42-1.35) | 23/211 | 50/302 | 0.66 (0.34-1.28) |
| Within 3 min | 35/350 | 79/506 | 0.67 (0.40-1.11) | 30/267 | 68/376 | 0.64 (0.37-1.10) |
| Within 4 min | 40/406 | 85/549 | 0.63 (0.39-1.01) | 35/306 | 74/404 | 0.63 (0.38-1.16) |
| Within 5 min | 41/435 | 94/587 | 0.63 (0.40-0.99) | 35/327 | 82/434 | 0.63 (0.38-1.04) |
| Within 6 min | 44/489 | 98/623 | 0.67 (0.40-1.11) | 37/366 | 86/458 | 0.57 (0.35-0.94) |

* Adjusted with year, age, etiology, and ECG wave

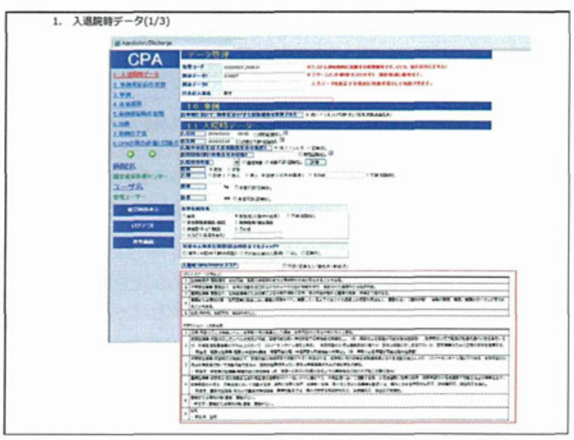
## Should NOT hesitate to start SOME ByCPR for witnessed paediatric OHCA




To make CC-only CPR effective for kids, you should not loose your time by sticking with conventional CPR at the beginning

## 学校心停止全国調査

- 日本小児循環器学会蘇生科学委員会の協力下で、全国に県毎の調査担当者を配置
- 総務省ウツタインデータを元に、各県毎の小中学生年齢の心停止症例数を把握、詳細調査を各県毎に実施する
- 発生場所が学校であれば、CPR実施状況に加え、AEDの配備状況・使用状況を調査に加える
- 全例、学校心臓検診結果との突合を行う
- レジストリは小児院内心停止レジストリ（J-NRCPR）のサーバとアプリケーションに載せる形にする




## 乳児

背景研究
科研計画

# H24 研究計画

【課 題】

- 家庭内における乳児心停止の際の、両親に対する「口答指示」の効果を最大限にするための普及方法は？
  - 乳児BLSセルフトレーニング・ツール使用前後での、胸骨圧迫・人工呼吸の口頭指導による実施率および手技評価の検討？
- 乳児BLSセルフトレーニング・ツール啓発に際して効果的戦略は？
  - 普及する側
  - 普及される側
- 小児院内心停止の発生場所は、海外に比して非ICU環境が多く、呼吸不全よりもショックによるものが多い。これらに対する対策（ショック状態の小児・乳児早期認識と早期介入策）も求められる。

# H24 研究計画

- 乳児に対するAED使用の事後検証をふくめた、小児病院前救護にかかる研究をアンケート調査等により実施し、政策提言につなげる。
- 救急隊配備の半自動除細動器の
  - 乳児適応
  - パッド配備
  - 解析精度
  - 事後検証等


Shimizu, 2011 ReSS

| Outcome analysis | n | ROSC | % | admit ICU | % | 1mo | % | favorable | % | 1y | % | favorable | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | | | |
| 0 | 65 | 12 | 19 | 11 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 - 7 | 62 | 15 | 24 | 9 | 15 | 4 | 6.5 | 1 | 1.6 | 1 | 1.6 | 1 | 1.6 |
| 8 - 15 | 60 | 20 | 33 | 12 | 20 | 5 | 8.3 | 3 | 5 | 3 | 5 | 3 | 5 |
| total | 187 | 47 | 25 | 32 | 17 | 9 | 4.8 | 4 | 2.1 | 4 | 2.1 | 4 | 2.1 |
| Asys/PEA | | | | | | | | | | | | | |
| 0 | 63 | 12 | 19 | 11 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 - 7 | 58 | 14 | 24 | 9 | 16 | 4 | 6.9 | 1 | 1.7 | 1 | 1.7 | 1 | 1.7 |
| 8 - 15 | 50 | 13 | 26 | 8 | 16 | 3 | 6 | 1 | 2 | 1 | 2 | 1 | 2 |
| total | 171 | 39 | 23 | 28 | 16 | 7 | 4.1 | 2 | 0.3 | 2 | 0.3 | 2 | 0.3 |
| VFVT (include 2nd) | | | | | | | | | | | | | |
| 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 - 7 | 4 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 - 15 | 10 | 7 | 70 | 4 | 40 | 2 | 20 | 2 | 20 | 2 | 20 | 2 | 20 |
| total | 16 | 8 | 50 | 4 | 40 | 2 | 20 | 2 | 20 | 2 | 20 | 2 | 20 |

| Location analysis | n | Public | % | witnessed | % | ByCPR | % | Home | % | witnessed | % | ByCPR | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | | | |
| 0 | 65 | 13 | 20 | 3 | [illegible] | 0 | [illegible] | 52 | 80 | 12 | [illegible] | 9 | [illegible] |
| 1 - 7 | 62 | 13 | 21 | 10 | 77 | 5 | 50 | 49 | 79 | 14 | 71 | 9 | 64 |
| 8 - 15 | 60 | 37 | 62 | 27 | 73 | 16 | 59 | 23 | 38 | 7 | 30 | 5 | 71 |
| total | 187 | 63 | 34 | 40 | 63 | 21 | 53 | 124 | 66 | 33 | 27 | 23 | 70 |
| Asys/PEA | | | | | | | | | | | | | |
| 0 | 63 | 13 | 21 | 3 | 23 | 0 | 0 | 50 | 79 | 11 | 22 | 9 | 82 |
| 1 - 7 | 58 | 12 | 21 | 9 | 75 | 5 | 56 | 46 | 79 | 12 | 26 | 8 | 67 |
| 8 - 15 | 50 | 30 | 60 | 21 | 70 | 11 | 52 | 20 | 40 | 4 | 20 | 3 | 75 |
| total | 171 | 55 | 32 | 33 | 60 | 16 | 48 | 116 | 68 | 27 | 23 | 20 | 74 |
| VFVT (include 2nd) | | | | | | | | | | | | | |
| 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 100 | 1 | 50 | 0 | 0 |
| 1 - 7 | 4 | 1 | 25 | 1 | 100 | 0 | 0 | 3 | 75 | 2 | 67 | 1 | 50 |
| 8 - 15 | 10 | 7 | 70 | 6 | 86 | 5 | 83 | 3 | 30 | 3 | 100 | 2 | 67 |
| total | 16 | 8 | 50 | 7 | 88 | 5 | 71 | 8 | 50 | 6 | 75 | 3 | 50 |

From 2008 SOS-KANTO Data

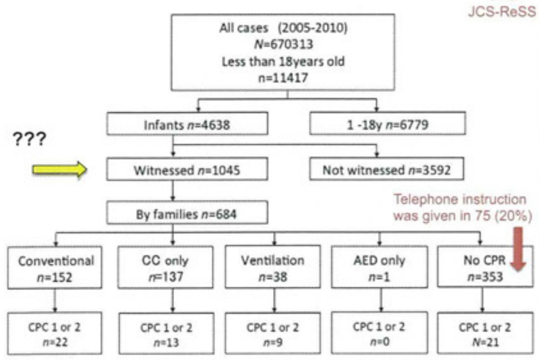
# Results from Children Witnessed by Citizens

## Infants vs. Children >= 1 y

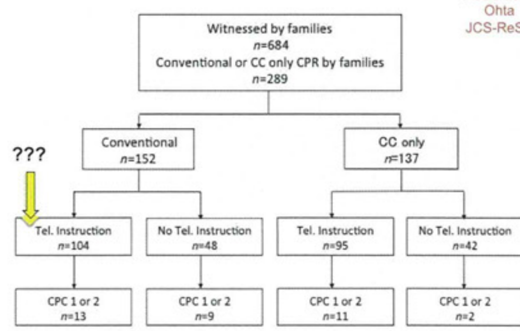
ReSS 2012
Shimizu
JCS-ReSS

| | Any Bystander CPR | No Bystander CPR | OR (95%CI) | CC only CPR | Conventional CPR | OR (95%CI) |
|---|---|---|---|---|---|---|
| Infants only | n = 387 | n = 397 | | n = 154 | n = 192 | |
| ROSC | 44 | 34 | 1.37 (0.86–2.19) | 16 | 22 | 0.90 (0.45–1.77) |
| 1mo. Survival | 71 | 57 | 1.34 (0.92–1.96) | 22 | 36 | 0.72 (0.41–0.47) |
| Favorable | 26 | 25 | 1.07 (0.61–1.89) | 8 | 14 | 0.70 (0.28–1.71) |
| Exclude Infants | n = 1009 | n = 1007 | | n = 423 | n = 514 | |
| ROSC | 191 | 89 | 2.41 (1.84–3.15) | 62 | 115 | 0.60 (0.42–0.84) |
| 1mo. Survival | 246 | 131 | 2.16 (1.71–2.72) | 79 | 151 | 0.55 (0.41–0.75) |
| Favorable | 145 | 52 | 3.08 (2.21–4.28) | 43 | 95 | 0.50 (0.34–0.77) |

ReSS 2012
Ohta
JCS-ReSS




ReSS 2012
Ohta
JCS-ReSS



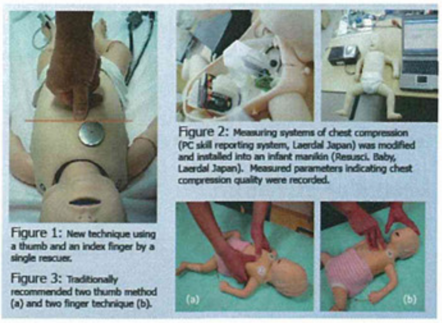


Figure 1: New technique using a thumb and an index finger by a single rescuer.

Figure 2: Measuring systems of chest compression (PC skill reporting system, Laerdal Japan) was modified and installed into an infant manikin (Resusci. Baby, Laerdal Japan). Measured parameters indicating chest compression quality were recorded.

Figure 3: Traditionally recommended two thumb method (a) and two finger technique (b).

Shimizu, et al., ReSS 200

Department of Paediatric Emergency & Critical Care Medicine, Tokyo Metropolitan Children's Medical Centre

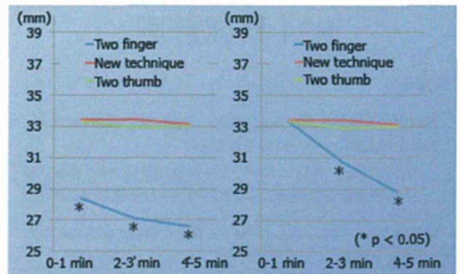



Figure 4a: without feedback.

Figure 4b: feedback was given with the results of chest compression depth for two finger technique group.

Shimizu, et al., ReSS 200

Department of Paediatric Emergency & Critical Care Medicine, Tokyo Metropolitan Children's Medical Centre

## 乳児心停止関連調査

- ミニベビー研修前後アンケート調査（自己効力感他）
- 11月20日保健師対象ミニベビー研修（金沢）

- 口頭指導について、実際の録音記録を入手可能か
- 解析ののち、口頭指導例（conventional, CC-only）を模擬的に作成し、市民対象に適正性を検証
- 胸骨圧迫手技として二本指法の適正性も検証

- infant witnessed CPA の詳細を調査
- TOR ?

## 報告内容

- 乳児を含めた小児一次救命処置（PBLS）の市民への普及、乳児に対するAEDを含めた小児病院前救護・口頭指導のあり方等、小児・乳児に対する<u>救急蘇生法の効果的普及</u>のための政策提言とする。

- わが国特有の学校心臓検診結果の有機的活用、家庭でのAEDホームユース、ならびに学校への<u>AED適正配置</u>についての政策提言と関連諸学会への働きかけにつなげる。

## H24 研究計画

【課 題】

- 家庭内における乳児心停止の際の、両親に対する「口答指示」の効果を最大限にするための普及方法は？
  - 乳児BLSセルフトレーニング・ツール使用前後での、胸骨圧迫・人工呼吸の口頭指導による実施率および手技評価の検討？

- 乳児BLSセルフトレーニング・ツール啓発に際して効果的戦略は？
  - 普及する側
  - 普及される側

- 小児院内心停止の発生場所は、海外に比して非ICU環境が多く、呼吸不全よりもショックによるものが多い。これらに対する対策（ショック状態の小児・乳児早期認識と早期介入策）も求められる。